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known 'Modern Classification of Insects,' in which the whole subject is treated in a masterly manner, as has been acknowledged by many most competent judges who have since profited by your labours. Of your more recent memoirs, which we have especially in view on this occasion, I may specify as particularly deserving of attention, those on the Cleridæ, Lucanidæ and Paussidæ, published in the Transactions of the Linnean, Entomological and Zoological Societies, your monographs on several Carabidous genera in Guérin's 'Revue Zoologique,' your contributions to Fossil Entomology in the Journal of the Geological Society, and the completion of the great work in folio commenced by Mr. Doubleday on the genera of the Diurnal Lepidoptera. Nor can I quite pass over your archæological researches, though these are not connected with the objects of this Society.

MR. WESTWOOD,—This Medal is presented to you in token of the interest which we take in your entomological researches, which reflect so much honour on your talents and zeal.

Obituary notices of deceased Fellows.

DR. MARTIN BARRY was born at Fratton, in Hampshire, on the 28th of March, 1802. Though originally designed for a mercantile career, his strong bent for scientific pursuits led to his embracing the medical profession, for which he studied in the Universities of Edinburgh, Paris, Erlangen, Heidelberg, and Berlin, as well as in some of the medical schools of London. He became a member of the Royal College of Surgeons of Edinburgh, and graduated as M.D. in the University of that city in 1833. During the period of his studentship he took an active part in the Medical, Royal Physical, and Wernerian Societies of Edinburgh, of which he was a member, and he was subsequently elected a Fellow of the Royal Society of Edinburgh. His love of fine natural scenery, and pursuit of botany and geology, led him to devote his college vacations usually to excursions in the mountain and lake districts of Scotland; and, after a session of study at Heidelberg in 1834, he spent the autumn of that year in a pedestrian tour through part of Switzerland.

In the course of these wanderings he arrived at Chamouni on the

15th of September, and, although it was then later in the season than any successful ascent of Mont Blanc had been achieved, Dr. Barry resolved upon the enterprise, and accomplished it with safety to himself and his guides. His was the sixteenth ascent that had been made: it occupied three days, owing to the unusual obstacles which the snow at that season presented; but the Doctor was rewarded by a magnificent view from the summit, and by weather so remarkably fine that "during the whole time he did not see a single cloud." In March 1836, Dr. Barry published an account of this ascent, which formed the subject of two Lectures delivered by him in Edinburgh, the proceeds of which he presented to the Royal Infirmary of that city. Baron Humboldt so highly esteemed the narrative and its author, that he personally requested Dr. Barry to translate from the German his (the Baron's) "Two attempts to ascend Chimborazo." This translation appeared in the *Edinburgh New Philosophical Journal*, 1837.

The difficult and recondite subject of animal development and embryology early attracted the young physician's attention, and he made himself intimately acquainted not only with the literature of that department of physiology, but with the eminent authors of the most valued works and treatises on those subjects. In the museums and laboratories of Professors Wagner, Purkinje, Valentin, and Schwann, Dr. Barry acquired that skill in microscopical investigations of which he subsequently made such excellent use.

He published a translation of the first part of 'Valentin's Manual of the History of Development,' in the *Edinburgh Medical and Surgical Journal* for 1836. From that period to 1840 he devoted himself exclusively to original researches on the development of the mammalian ovum and embryo, which at the time when he took up the subject was the darkest part of embryological science. The results of these researches were communicated to the Royal Society of London in three successive memoirs, entitled "Researches in Embryology." The 'First Series' was printed in the *Philosophical Transactions* for 1838; the 'Second Series' in the volume for 1839; the 'Third Series,' entitled "A Contribution to the Physiology of Cells," in that for 1840. In the same year Dr. Barry communicated a memoir "On the Corpuscles of the Blood," printed in the *Philosophical Transactions* for 1840. The *Philosophical Transactions* for 1841 contain his memoirs "On the Formation of the Chorion,"

"On the Chorda dorsalis," and two supplementary memoirs "On the Corpuscles of the Blood." The volume of the Transactions for 1842 contains his memoir "On Fibre," and that for 1843 his capital discovery of the "Spermatozoa found *within* the Ovum."

These Researches in Embryology contain a comprehensive, well-selected and well-conducted series of original experiments and observations on the formation and earlier stages of development of the ovum in the Rabbit and Dog, and in examples of the oviparous vertebrate classes from the bird to the fish. In the first series the author determined the order of formation of the different parts of the ovum, and the nature and mode of development of the vesicle called 'ovisac,' in which those processes take place. He made known the nature and traced the development of the so-called "disc of Von Baer," and detected in it a peculiar mechanism (retinacula) which he supposed mainly to regulate the transit of the ovum into the Fallopian tube. In the second series Dr. Barry traced the changes which the ovum undergoes in its passage through the Fallopian tube; the earliest and most interesting stages of mammalian development being for the first time described in this memoir. The important discovery of the segmentation of the yolk of the mammalian ovum is communicated in this memoir (1839), in which he first extended to that class the observation of a phenomenon which had previously been known only in the Batrachia. Dr. Barry's discovery made on the ovum of the Rabbit, was subsequently confirmed by Prof. Bischoff, in the ovum of the Dog and Guinea-pig.

Another most important observation, communicated by Dr. Barry to the Royal Society, in his Third Series, 1840, of the penetration by the spermatozoon of the ovum in the Rabbit, by an aperture in the zona pellucida, was of so minute and difficult a kind that it did not at once command assent. In 1843, Dr. Barry, however, published a confirmatory observation, which he had then made, of spermatozoa within the ovum of the Rabbit, taken from the Fallopian tube and in process of segmentation.

These statements at first met with positive denial by Professor Bischoff, who had failed in his attempts to repeat Dr. Barry's observations: and it was not until nine years afterwards that the observations of Dr. Nelson, on the impregnation of the *Ascaris mystax**,

* Philosophical Transactions, 1851.

gave a corroboration of the fact of the penetration of the ovum by the spermatozoa. Mr. Newport next discovered the spermatozoa within the ovum of the Frog. Meissner soon after confirmed the fact that the spermatozoon penetrates the interior of the ovum of the Rabbit; and, finally, Prof. Bischoff satisfied himself of the truth of Dr. Barry's discovery, which he had been the first to call in question.

Dr. Martin Barry was elected a Fellow of the Royal Society of London on the 13th of February, 1840, and so highly were his communications esteemed by the Society, that the Royal Medal was awarded to him, November 30th, 1839.

Dr. Barry's embryological researches were followed by observations on the formation and changes of the primitive cells in the origin and growth of the tissues of the animal body, and he arrived at new and important conclusions on the importance and functions of the cell-nucleus.

In his memoir "On Fibre," Dr. Barry first promulgated his views as to the ultimate spiral structure of the muscular fibre; and he subsequently extended the same views to most of the tissues of organized bodies. These opinions have not been confirmed or accepted by histologists; although Dr. Barry had latterly the satisfaction of citing a few microscopical observations of eminent botanists which seemed to lend support to certain applications of his favourite idea. "Now that he is no more," writes an eminent physiologist, "it will be more pleasing to endeavour to extract that which was good and true in his works, rather than discuss their doubtful and contested points." And Professor Allen Thomson, in the same biographical sketch, writes, "It cannot be doubted that Dr. Barry's researches as a whole gave a decided impulse to the progress of knowledge in the departments of which they treat, partly by the actual contribution of new and valuable facts, and partly by the ingenuity of his speculative views, the vigour with which they were supported, and the discussions to which they gave rise."

Dr. Barry's latest contributions to science were chiefly notices and comments on the observations of other histologists and physiologists, which appeared to confirm or countenance his views of the cell-nucleus, the primitive fibre, and the penetration of the zona pellucida by the spermatozoon. "The last few months of his life were employed in a review of his microscopic observations, and in

forming, at the request of foreign physiologists, an abstract of them, to be published in Germany. Some portion of this work occupied his last hours, and he appeared to have a satisfaction in having done with it, as one leaving the world*."

The private circumstances of Dr. Martin Barry were such as enabled him to dispense with the pursuit of the practice of his profession as a means of support. The proportion of his time so saved was devoted to the poor, and chiefly in connexion with some public institution. In the year 1844, after the publication of his most original and important observations, and after receiving the high testimonial of the Royal Medal from the Royal Society of London, he accepted the office of House-surgeon to the Royal Maternity Hospital in Edinburgh; and Professor Simpson, the director of the institution, speaks of Dr. M. Barry as "our invaluable house-surgeon, and a gentleman to whose talents, zeal, and humanity the hospital is deeply indebted for its prosperity." Dr. M. Barry reared up diligent students, notwithstanding the harassing nature of the duties of a midwifery pupil; and his kindness, promptness, and unweariedness in rendering aid to the poor distressed parturient females in Edinburgh have made his name still gratefully remembered amongst them.

From 1849 to 1853, Dr. Barry's health, and especially his eyesight, having become affected by his close and persevering studies, he was induced to return to the continent, and resided successively at Göttingen, Giessen, Breslau, and Prague. At the latter city he resumed his microscopic studies of muscular fibre, with the co-operation of his friend Professor Purkinje; and the result of their combined researches is given in Müller's Archives for 1850, and in a translated abstract in the Philosophical Journal for August 1852.

In that year he revisited Scotland, and resided occasionally in Arran, Rothesay, and Edinburgh. His friends deeply grieved to witness, in his emaciated frame, the evidence of progressive malady. He suffered much from neuralgic pains, being deprived, therefrom, of rest for nights in succession. In the autumn of 1853 he finally took up his abode at Beccles, Suffolk, near his brother-in-law, Dr. Dashwood, who married Dr. Barry's only sister. Soothed and sustained by the devoted attention of his affectionate relatives, he

* Biographical Memoir in the Edin. Med. Journal.

lingered, with intellect unimpaired, and power of labour little abated, until the 27th of April, 1855. On that day, in the immediate prospect of death, he said, "All is peace;" then added, "even now;" and soon afterwards passed away, full of a Christian's hope.

SIR HENRY THOMAS DE LA BECHE, C.B., F.R.S., F.G.S., Corr. Memb. of the Academy of Sciences of Paris, &c. &c., was born in London, February 10, 1796, married in 1818, received knighthood in 1842, was nominated C.B. in 1848, and died April 13, 1855. His education was conducted partly at home, partly at Keynsham and Ottery St. Mary, till in 1810 or 1811 he went to the Military College at Marlow. In 1817 he became F.G.S., and was admitted F.R.S. in 1819. From this epoch the prevalent bias of his mind toward Natural Science was manifested in a long series of valuable contributions to Geology, for the most part founded on personal research in districts to which he was ever partial, attached by early associations or allured by the instincts of an artist.

The southern coasts of England and Wales offered to the young and zealous student a series of interesting phenomena, at that time little explored,—rocks of sedimentary origin, exhibited in unusual circumstances; an uncommon variety of granites, greenstones, porphyries, and other rocks of fusion; singular complications of mineral veins, modern land-slips, ancient upheavings of strata, and undescribed organic remains. To all of these De la Beche brought a mind prepared; they became for him the main object of his observation and meditation; he returned to them again and again, fortified by the experience gathered in other parts of the world, and supported by the scientific alliance and strong personal regard of Buckland and Conybeare. Here was the centre of his field of inquiry, here his scientific life began, here he earned his fame, and it was while meditating and directing new labours in this favourite region, that he sunk to his long repose.

The following are some of his publications on the subjects alluded to :—

1819. *The Rocks and Fossils of Devon.* Geol. Trans.

1823. *On the Geology of the South-East of England, from Bridport Harbour to Babbacombe Bay.*

On the Discovery of an Elephant's Tusk near Charmouth. Geol. Trans. 2nd ser. i. 421.

1825. On the Geology of Southern Pembrokeshire. *Geol. Trans.* 2nd ser. ii. 1.
 On the Lias of the Coast in the vicinity of Lyme Regis. *Geol. Trans.* 2nd ser. ii. 21.
 On a Submarine Forest at Charmouth. *Ann. Phil.* xi. p. 143.
1826. On the Chalk and Sands beneath it in the vicinity of Lyme Regis and Beer. *Geol. Trans.* 2nd ser. ii. 109.
1827. On the Geology of Tor and Babbacombe Bays. *Geol. Trans.* 2nd ser. iii. 161.
1830. On the Geology of Weymouth (in conjunction with the Rev. Dr. Buckland). *Geol. Trans.* 2nd ser. iv. 1.
1834. On the Anthracite near Bideford. *Proc. Geol. Soc.* ii. 106.
1835. On the Trappean Rocks associated with the New Red Sandstone of Devonshire. *Proc. Geol. Soc.* ii. 196.
 On Fossils from the Schistose Rocks of the North of Cornwall. *Proc. Geol. Soc.* ii. 225.
1836. Lettre sur la découverte d'Empreintes de Plantes dans les Schistes subordonnés de la Grauwacké. *Bull. Géol. Soc. Fr.* vi. 90.
1839. Report on the Geology of Cornwall, Devon, and West Somerset. 8vo.
1846. On the Formation of the Rocks of South Wales and South-Western England. *Mem. Geol. Surv.* i. p. 1.
 On the Connexion between Geology and Agriculture in Cornwall, Devon, and West Somerset. *Journ. Agr. Soc. Eng.* iii. 21.

The natural history of the same region had other charms for the enterprising spirit of De la Beche. To dredge the sea, to gather the living wonders of the deep, suited the bold swimmer and skilful boatman; to examine the structure and habits of marine creatures was not less congenial to the microscopic observer and the accurate and forcible artist. The "Notes on the Habits of a Caryophyllia from Torquay" (*Zool. Journ.* 1828), and the "Catalogue of the Birds and Mollusca in the vicinity of Geneva," are indeed all that remain to mark the strong interest felt by De la Beche in recent Natural History; but they who have accompanied him over miles of land and sea know well the untiring delight with which, even in later life, he would scrutinize the isochronous movements of *Rhizostoma*,—the varying hues of *Octopus*,—the sensibility to light of the *Bryozoa*,—how sharp his attention to the peculiar instincts of the animal creation.

To such a mind came easily and naturally the inquiry into the osteological relations of the huge fossil reptilia, so long known, but so little understood by the collectors of fossils at Bath, Glastonbury

and Lyme Regis,—an inquiry which in the hands of Conybeare and De la Beche gave us the *Plesiosaurus*, that singular “link between *Ichthyosaurus* and *Crocodile*.” (*Geol. Trans.* 1823, 1 ser. v.)

Love of scenery and ill-health induced him to prolonged residence abroad, and in 1819 and subsequent years we find him mapping and sounding the lake of Geneva—in 1823, tracing the geology of the north coast of France, examining the fossil plants of the Col de Balme—in 1824, 1825, exploring the geology of Jamaica, where lay his paternal estates—in 1828 and 1830, reporting on the geology of Nice and the Gulf of La Spezia.

In the midst of all his pleasant labour, De la Beche found time to prepare selections from the valuable memoirs in the *Ann. des Mines* (1824); ‘*A Tabular View of the Classification of Rocks*’ (1827); ‘*Geological Notes*’ (1830); ‘*Sections and Views of Geological Phenomena*’ (1830); ‘*A Geological Manual*’ (1831); ‘*Researches in Theoretical Geology*’ (1834); ‘*How to Observe*’ (1835); ‘*The Geological Observer*’ (1851). He officiated as Secretary of the Geological Society (1831), as Foreign Secretary from 1835 to 1846, and as President, 1848 and 1849. He was appointed Corresponding Member of the Academy of Sciences in 1853.

But the most important results of the labours of this eminent observer are contained in those valuable Geological Maps of the British Isles, which have been prepared partly by his hands, but entirely by his direction.

That which had been vainly solicited by the interests of agriculture in 1805, was conceded to the urgency of geology in 1832: the ‘*Ordnance Geological Survey*’ was begun, with De la Beche for its head or rather only officer, in the mining districts of Devon and Cornwall. From this epoch began a new era of British Geology, characterized by a minuteness of field surveying previously unknown, by exact measurements of the thickness and inclination of strata, by published maps and sections of unequalled truth and beauty. De la Beche’s maps of the great western district,—one of the most difficult tracts in Britain for the geological surveyor,—appeared with a valuable explanatory report in 1839. In the map which accompanies the volume, the older strata of North and South Devon are called ‘*Grauwacke*.’ Their true relation to the old red sandstone groups, suggested by Lonsdale, Murchison, and Sedgwick,

was adopted in 1840 by the Director of the Survey, and made the subject of a separate volume drawn up by one of his friends.

From Cornwall and Devon the 'Ordnance Geological Survey' was transferred to South Wales, and before the close of 1841, the Director, with his staff of geologists, had measured the Palæozoic strata in all the cliffs of Pembrokeshire, and constructed maps extending from St. Bride's Bay to the sources of the Usk. In this large area the problem of the succession of strata has a different aspect from that which is presented in the eastern and northern parts of the Principality, and the distribution of ancient life offers many points for inquiry. These phenomena were discussed in the early memoirs of the Geological Survey, after an opportunity had been afforded of comparing them in detail with the typical Silurian tracts of Malvern and Ludlow, rendered famous by the earlier labours of Murchison.

Those who at this time shared the society of Sir Henry De la Beche in the field, experienced an enjoyment of no common description. Ill-health, the cares of office, anxieties of every kind, were swept away by the mountain wind, or forgotten amidst the glancing waves; every day brought new facts to an indefatigable observer, new scenes of beauty to an enthusiast in art, new occasions for profound reflection, sagacious inference, and practical instruction to his young companions. In after-years the Survey became too extended to admit of the same personal superintendence in every part. Separated from the 'Ordnance Survey' in 1845, it assumed the shape of a department, received local Directors for England and Ireland, an augmented staff, laboratory, lecture-room, and museum in London.

Over all this large establishment, the realization of his own plan, Sir H. T. De la Beche presided with the unflagging resolution which had brought it into being,—presided, indeed, too long. The strength which grew under the hammer, and rejoiced in long days of wandering over rocky hills, faded away among the official niceties and impediments of his great office; but he clung to his self-destroying work, and had before his death the satisfaction of seeing in full operation that Mining School, that Palæontological Museum, that systematic field geology, and professional teaching in practical science which he had kept steadily in prospect for twenty years.

In Sir Henry De la Beche, an active, prudent, and successful administrator has been withdrawn from the public service; but a far heavier loss is deplored in that branch of science in which he won his renown, and whose foremost cultivators were his friends, fellow-labourers, and disciples.

MR. BRYAN DONKIN was born at Sandoe, Northumberland, on the 22nd of March, 1768. His taste for science and mechanics soon showed itself; and he was, almost as a child, continually to be found in his little workshop, making thermometers and ingenious contrivances connected with machinery of all kinds. This mechanical turn of mind was ultimately encouraged by his father, who was agent for the Errington and other estates, and who had formed the acquaintance of John Smeaton, the eminent engineer, from having frequent occasion to consult him on questions relating to the bridges and other works on the Tyne.

On leaving home, the son began life in the same business as his father, being engaged for a year or two as Land Agent to the Duke of Dorset at Knowle Park, Kent. Soon, however, the bent of his genius showed itself, by his leaving the Duke's agency, and going to consult Mr. Smeaton as to the best course to pursue to become an engineer. By Smeaton's recommendation, he apprenticed himself to Mr. Hall, of Dartford, and was soon able to take an active part in Mr. Hall's works; so that, in 1801-2, he was entrusted principally with the construction of a model of the first machine for making paper, the execution of which had been put into Mr. Hall's hands by the Messrs. Fourdrinier.

The idea of this machine originated with Mr. Roberts, and formed the subject of a patent obtained by Mr. Gamble, which was assigned to Messrs. Bloxam and Fourdrinier. After some time had been spent and considerable expense incurred, many attempts were made to set the model to work, but in none of these trials was any paper produced fit for sale.

The model remained at Mr. Hall's works until 1802, when Mr. Donkin agreed with Messrs. Bloxam and Fourdrinier to take the matter in hand; and, having taken premises at Bermondsey (still occupied by his sons), he made a machine, and erected it, in 1804, at Frogmore, Herts. On putting this machine to work, it was found

successful, but yet far from perfect. A second machine was made by Mr. Donkin, and erected, in 1805, at Twowaters, Herts, in which he introduced further improvements, although much still remained to be done. However, in 1810, eighteen of these complex machines had been erected at various mills, some of which are even now at work ; and, at this period, having overcome the practical difficulties, Mr. Donkin erected in this, and various foreign countries, many similar machines, which rapidly superseded the method of making paper by hand. Thus for eight years Mr. Donkin gave his time and skill almost wholly to this one object ; and his perseverance was crowned with signal success ; for, although the original idea was not his, the credit of its entire practical development is due to Mr. Donkin.

The paper machine, of which at this time about two hundred have been made and erected by Mr. Donkin and his sons, ranks amongst the most useful and complete of mechanical contrivances ; carrying the process uninterruptedly from the liquid pulp to the perfect sheet of paper, ready for writing or printing. The merit of these and of the later improvements introduced by the Messrs. Donkin was recognized by the award of the Council Medal at the Great Exhibition of 1851.

Mr. Donkin was also one of the earliest to introduce improvements in printing machinery. In 1813, he, in conjunction with Mr. Bacon, secured a patent for his Polygonal printing machine ; and one was erected for the Cambridge University. It was then also he invented and first used the composition printing-rollers, by which some of the greatest difficulties hitherto experienced in printing by machines were overcome.

Mr. Koenig and Mr. Cowper both used these rollers in their patent printing-machines, with Mr. Donkin's permission, which must be considered an act of the greatest liberality, since without these rollers no such machine can work. With the Polygonal machine, from 800 to 1000 impressions were produced per hour ; but it never came into extensive use, as the construction was expensive, while the work produced was of a quality beyond that required in machine printing.

Mr. Donkin was also much engaged with Sir William Congreve, in 1820, in contriving a method of printing stamps in two colours, with compound plates, for the prevention of forgery ; and, with the

aid of Mr. Wilks, who was then his partner, he produced the beautiful machine now used at the Excise and Stamp Offices, and by the East India Company at Calcutta.

Amongst the many inventions and ingenious processes in the promotion of which Mr. Donkin materially assisted, was the method of preserving meats and vegetables in air-tight cases. His attention was called to this subject in the year 1812, when he established a considerable manufactory for this purpose in Bermondsey. The introduction of this process has been of great public benefit; and on long sea voyages meat preserved in this way has become a necessary part of the stores of every well-appointed vessel.

Mr. Donkin was an early member of the Society of Arts, of which he was one of the Vice-Presidents; and as Chairman of the Committee of Mechanics, an office he held for many years, the soundness of his judgment and the urbanity of his manners made him much esteemed and beloved. He received two gold medals from the Society; one for his invention of an instrument to measure the velocity of rotation of machinery, the other for his admirable counting engine.

Although our space will not allow us to notice the various other inventions and improvements in machinery due to Mr. Donkin, we cannot pass over in silence his exquisite dividing and screw-cutting engine.

Mr. Donkin was much engaged during the last forty years of his life as a civil engineer, and was one of the originators and a Vice-President of the Institution of Civil Engineers, which was founded by one of his pupils, Mr. Henry Palmer, with a few other gentlemen; and Mr. Telford with Mr. Donkin obtained the Royal Charter for that body. In 1838 he was elected a Fellow of the Royal Society, and repeatedly served on the Council. He was also a member of the Royal Astronomical Society, and was held in such esteem by that body, that they placed him in the Chair on the occasion of receiving their Charter. He had, moreover, a small observatory in his garden, where he spent much of his leisure time; and it was to his own transit that he first applied his novel and beautiful level.

For many years Mr. Donkin was a magistrate for the county of Surrey, and, up to within a short time of his death, was very

regular and assiduous in the discharge of his duties. His life was one uninterrupted course of usefulness and good purpose; and he died on the 27th of February, 1855, after enjoying that general esteem and respect which render old age serene and happy.

It is now more than sixty years since CHARLES FREDERIC GAUSS, a young student resident in the city of Brunswick, hit upon an important theorem in the theory of numbers. His father was a brick-layer in very humble circumstances, who was anxious that his son should follow his own occupation; but the extraordinary capacity of the boy, at that time attending the National School, had attracted the attention of Bartels, afterwards Professor at Dorpat and the father-in-law of the great Astronomer Struve; and it was upon his recommendation that the reigning Duke, in spite of the opposition of the father, provided him with the means of a good classical education, by sending him to the Collegium Carolinum, and by many subsequent acts of kindness and patronage. The proposition which he had discovered, appeared to its author to be one of no ordinary beauty; and as he conjectured that it was connected with others of still greater value and generality, he applied—as he himself assures us—all the powers of his mind to find out the principles upon which it rested and to establish its truth by a rigid demonstration. Having fully succeeded in this object, he felt himself so completely fascinated by this class of researches, that he found it impossible to abandon them, and he was thus conducted from one truth to another, until he had finished the greatest part of the first and most original, if not the greatest, of his works, before he had read the writings of any of his precursors in this department of science, more especially those of Euler and La Grange. The subsequent study of the arithmetical researches of these great masters of analysis could hardly fail to expose him to the mortification which young men of premature and creative genius have so often experienced, of finding that they have been anticipated in some of their finest speculations. So far, however, from being repelled by this discovery, “I became,” says he, “animated with fresh ardour, and by treading in their footsteps, I felt fortified in my resolution to push forward the boundaries of this wide department of science.” The crowning result of his labours was, as is well known, the complete solution of binomial equations, and a most unexpected

extension of the limits within which the geometrical division of the circle had hitherto been confined ; a discovery sufficiently memorable to form a great epoch in the history of the progress of geometry and analysis, and to place its author, in the estimation of the few persons who would appreciate its value, in the highest rank of the mathematicians of his age.

In dedicating his '*Disquisitiones Arithmeticæ*' to the Duke of Brunswick, he acknowledges in very touching terms the wise and liberal patronage which had not only provided for the expenses of publishing his work, but also enabled him to exchange permanently the humble pursuits of trade for those of science. The work itself, as its author assures us, assumed many changes of form in its progress to maturity, as new views presented themselves from time to time to his mind ; but, as is well known, the course which is followed in the invention of new truths is rarely that which is most favourable to clearness in their exposition, more especially when it has been pursued in solitude, with little communication with other minds ; whilst the peculiar terminology which he has employed in the classification of numbers and their relations, and which is so completely embodied in the enunciation and demonstration of nearly every proposition that it can never be absent from the mind of the reader, renders the study of this work so laborious and embarrassing, that few persons have ever mastered its contents. Even Legendre, who had written so much and so successfully on the same subject, and who, in the second edition of his '*Théorie des Nombres*,' makes the great discovery which this work contains the occasion not merely of special investigation but of the most emphatic praise, complains of the great difficulty of adapting its forms of exposition to his own ; whilst the writers of the '*Biographie des Contemporains*,' in a notice of the author at a much later period, when he had established many other and almost equally unquestionable claims to immortality, quote an extract from a Report of a Commission of the Institute of France, to whom it was referred in 1810, in which it is said, "that it was impossible for them to give an idea of this work, inasmuch as everything in it is new, and surpasses our comprehension even in its language." The biographers then proceed to stigmatize the book as full of puerilities, and refer to the success which it had obtained, including its translation into two languages, as affording grounds

for the presumption that “charlatanism sometimes extended even to the domain of the mathematics.”

The first day of the present century was signalized by the discovery of the planet Ceres at Palermo, and before the first observations of the discoverer—only two in number—had been made known to astronomers, the planet had ceased to be observable from her proximity to the sun. The planet Uranus had been discovered twenty years before, when near opposition; this was a critical position, which at once gave a near approximation to the elements of his orbit: a stationary elongation of Ceres, though less fertile in its results, was sufficient to assign her such a place between Mars and Jupiter as was required to satisfy Bode’s singular law, the recent announcement of which had already stimulated an enthusiastic band of German astronomers to commence a systematic search for the planet, which Kepler had found wanting for the fulfilment of one of that series of cosmical speculations which had guided him to the discovery of his laws. The complete determination, however, of the elements of a planet’s orbit from three geocentric longitudes and latitudes—or from four of the first and two of the second in those cases where the latitudes are evanescent or small—was still therefore a new problem which had only been completely solved in the case of comets moving in parabolic orbits, and which Newton, to whom its first solution was due, had pronounced to be *problema omnium longe difficillimum*.

It was not until the month of October following the discovery of Ceres, that Gauss came into possession of the requisite observations, and in the course of a few weeks he had determined the elements of her orbit with an accuracy fully commensurate with the observations; so much so, indeed, that the Baron de Zach was enabled to rediscover the planet at the very first attempt which he made for that purpose on the 7th of December following. The elements of Pallas, Juno, and Vesta, the discovery of which followed that of Ceres at no great distance of time, were promptly determined by methods substantially the same, but materially improved by new artifices and adaptations of formulæ which an enlarged study and application had enabled him to give them.

The “*Theoria motuum corporum cœlestium in conicis sectionibus circa solem ambientium*,” which contains not only the exposition of these methods and their detailed exemplifications, but a most elabo-

rate discussion of the various problems which present themselves in the determination of the movements of planets and comets from observations made on them under any circumstances, was not published before 1809. Gauss was not usually very prompt in making public his researches, but retained them in his own hands until, by repeated correction and examination, they had assumed a form which satisfied his own judgment of what was equally due to the requirements of science and his own honour; and the work of which we are now speaking exhibits, in a very remarkable degree, the effects of this severe system of revision, in the skilful adaptation and reduction of methods and formulæ, and in the careful estimate of the circumstances under which they may be most advantageously employed. We find in it no evasion of difficulties, and no resort to methods of approximation only, when the means of accurate determination are at hand. His aim was in every instance to obtain results of the same order of correctness with the observations upon which they were founded; and with a view of securing the full benefit of observations which furnish, as is usual in astronomy, data more numerous than the unknown elements which they are required to determine, he has given in the work which we are now considering the first completely developed theory of the method of *least squares*, more especially as applicable to astronomy, and of the means of estimating the degree or measure of precision which its application affords; and though he was anticipated in the publication of this method by Legendre, there is every reason to believe that it was with him an original discovery; for he is said to have been in possession of it as early as 1795. No other work in later times has contributed so much as this to the complete and scientific discussion of astronomical observations; and its influence is traceable in the form which those discussions have assumed in the writings of Bessel, Hansen, Struve, Encke, and other eminent astronomers, which have done so much honour to Germany.

It would be impossible in the brief space allowed for this notice to pass in review Gauss's various essays on subjects of pure and applied mathematics—some of them of great importance—which were generally communicated to the Royal Society of Göttingen, though most of them were separately published: amongst them we find two demonstrations of the resolvability of equations with rational terms into simple or quadratic factors; others on magic squares; on qua-

dratic residuals ; on a new method of determining integrals by approximation founded on Newton's method for that purpose ; on the theory of curve surfaces ; on the theory of capillary attraction, and on various subjects in dioptrics and astronomy : there is one memoir of more than common interest, devoted to the demonstration of a very remarkable proposition in the planetary theory, which is, that the secular variations which the elements of the orbit of a planet would experience from another planet which disturbs it, are the same as if the mass of the disturbing planet were distributed into an elliptic ring coincident with its orbit, in such a manner that equal masses of the ring would correspond to portions of the orbit described in equal times.

It was in the course of this last investigation that he arrived at some elliptic integrals, the evaluation of which he was enabled to effect by means of a transformation which is included in one of the series of transformations, the discovery of which will immortalize the name of Jacobi. It has been said—though we do not vouch for the truth of the anecdote—that this distinguished analyst was induced by his knowledge of this fact to seek—after his own discoveries were completed—an interview with the great mathematician who had thus intruded, prematurely as it were, into one of the deepest recesses of his own province : Jacobi submitted his various theorems to his inspection, and was met, as they successively appeared, by others of corresponding character and import produced from his manuscript stores, concluding with an intimation that there were still many more in reserve. Such an anticipation of discoveries, which totally changed the aspect of this difficult department of analysis, even if it had been as complete as it is here represented to have been, would have been no derogation of the rights which Jacobi has undeniably secured by priority of publication ; but the wide circulation which has been given to this story, as well as our own knowledge of Gauss's habitual delay in the publication of his researches, have tended not a little to increase our anxiety to be put in possession of the various scientific treasures which he is said to have left behind him. It is to Lejeune Dirichlet that this task has been entrusted, and there are few living analysts so likely to perform it satisfactorily.

We now enter upon the last, and perhaps the most considerable

of Gauss's researches, which are contained in his various essays, both theoretical and practical, on the magnetism of the earth.

Of the three magnetic elements, the declination, the dip, and the intensity, the two first were formerly the almost exclusive objects of observation, though the methods which were employed for that purpose were generally too rude for the requirements of accurate science; but the third, or magnetic intensity, of which no use had been made in the business of navigation, was entirely neglected.

Humboldt first called the attention of philosophers to the great theoretical importance of this element, and he omitted no opportunity, in the course of his travels, of determining its value.

It was during his Arctic voyages that the attention of Colonel Sabine had been forcibly called to the consideration of this subject by the remarkable magnetical phenomena observed when approaching the magnetic pole; and it was principally due to his influence and example, and to the labours of Hansteen, Erman, and other eminent travellers and navigators, that observations of the intensity were rapidly multiplied in every part of the globe, and more especially in Siberia, which had been generally believed to be the site of a second northern magnetic pole. These observations, 753 in number, in 670 different localities, were collected, arranged, and discussed in an admirable report which was made by Colonel Sabine to the British Association in 1837; and it is not one of the least of the many claims of its author upon the gratitude of men of science, more especially in connexion with magnetic researches, that it not only suggested to Gauss—as he himself declares—his bold attempt to grapple with the general theory of terrestrial magnetism, but furnished him with the materials for testing the applicability at least, if not for establishing the truth, of the theory which he proposed.

The observations of the terrestrial intensity which had hitherto been made were comparative only, and it was with a view of converting such comparative into absolute measures, with reference to determinate units, that Gauss undertook the series of investigations which are recorded in his memoir, entitled "*Intensitas vis magneticæ terrestris ad mensuram absolutam revocata*," which was published in 1832. He was assisted in these experiments, as in all others that he made, by Weber, a philosopher who is well known by his "*Wellen-*

lehre," written in conjunction with his brother, as well as by many other works of his own, but who felt that he was honoured by the privilege of combining his labours with those of so great a master. The units of reference which were chosen by Gauss were the millimetre in length, the milligramme in weight, and the second in time; and the horizontal intensity at Göttingen, in terms of these units, was found to be 1.7625, which gives, assuming a dip of $68^{\circ} 1'$, a total intensity represented by 4.7414.

It followed, as another consequence of this inquiry, and which may serve to give us a conception of the vast forces with which we have to deal, that the magnetism of the earth might be replaced in external space by the combined action of 8464 trillions of magnet bars, with parallel axes of the weight of one pound each; or, if we should assume the magnetism of the earth to be uniformly distributed throughout its substance, the magnetism contained in four cubic feet of its matter would be nearly equivalent to one such magnet.

The publication of this memoir, a model of the union of experimental and theoretical research, produced no ordinary effect upon men of science, particularly in Germany. It was felt that the time had arrived when the same precision which had thus been found to be attainable in the absolute determination of one of the magnetic elements, would not only be equally so in the determination of the others, but also of the changes, whether periodical or occasional, which they were known or suspected to undergo. Were the disturbances of the needle, which had been observed to be produced at distant places by the aurora borealis, or other less manifest causes, absolutely simultaneous; or were they not so? A magnetical observatory, for the purpose of making the observations which these inquiries suggested, was established at Göttingen, under the superintendence of Gauss and Weber, by whom also instruments were designed which were capable of giving results incomparably more accurate than any which had hitherto been attained. Observatories on the same model were formed in various cities in Germany, and ultimately at Greenwich; the members also of a widely-spread magnetical association engaged themselves to make simultaneous observations on certain term-days and hours; and the fine series of magnetical observatories which were subsequently established at the Cape of Good Hope, Hobarton, Toronto, and elsewhere,

and furnished in almost every instance with a numerous and well-organized staff of observers, was the final triumph of a system which had originated at Göttingen, and which has already sufficiently pointed out the general laws, as well as the anomalies of magnetic action, though unhappily it has hitherto left the physical causes which give rise to them almost entirely untouched.

We have already referred to the circumstances which suggested the celebrated Memoir "On the Theory of the Earth's Magnetism," which was published in 1839. There is, properly speaking, only one known physical principle which can be assumed for its basis, which is the variation of the magnetic forces, according to the inverse square of their distances. It is this principle which brings into operation a function, named by later writers the *potential* function, which had been already extensively used by La Place and Poisson in some of their most difficult investigations arising out of the theory of gravitation. The differential coefficients of this function would express the coordinate components which determine the direction and intensity of the earth's magnetism, and provided they were known, they would assign the three elements which we are in search of; but inasmuch as the law of the distribution of magnetism within the earth is altogether unknown, so likewise is the form of its potential function, and the process of deduction of the conclusions which we are required to draw from it would thus appear to be stopped at its origin. Yet there are some general properties of the function itself, and some also which are deducible from the known conditions which it is required to satisfy, which have enabled this great master of his art, with singular sagacity and skill, to make even the dumb to speak, and to give responses which are of the highest philosophical import.

Such is the clear conception, which he educes from it, of the characteristic property of a magnetic pole, and the necessary consequence resulting from it, that there can be only one northern and one southern pole; and the consequent effectual dissipation of the conclusion which so many eminent philosophers had drawn from their observations, that there were two northern, and by a natural inference, therefore, two southern magnetic poles. Such also was the remarkable proposition, that if the component of the horizontal magnetic force directed towards the north was given for the whole

surface of the earth, then the horizontal component directed towards the east or west would follow of itself; and not less remarkable was the consequence deducible from this, that the knowledge of the value of the potential function which the horizontal component, as above stated, would furnish for all points of the earth's surface, would also give its value for all points of external space. But of all the conclusions which this memoir contained, those which excited the most sanguine hopes of the ultimate and complete solution of the great problem of the earth's magnetism, were the successive theorems in which he showed that the components of the magnetic force for any point of the earth's surface may be represented by combining, with given functions of the latitude and longitude of that point, certain constant coefficients—of which not more than twenty-four were likely to be required—which were deducible from a sufficient number of the observed values of those components in different and assigned localities.

The calculation of these coefficients, a work of no ordinary labour, was effected by the author of this theory; and the results which they afforded were compared with their values, as given by observation, at ninety-one stations. The discrepancies between observation and theory, which were shown by these results, were not more considerable than might have been expected from the inadequate extent to which the calculations had been carried, and from the necessarily imperfect character of the data which were made subservient to them. The calculation of the same coefficients was renewed, and greatly extended, by Petersen, under the direction of the younger Erman, at the request and expense of the British Association, and the results are published amongst their Reports for 1847. Some of these results would seem, however, rather to indicate defects in the theory than errors of the observations, and it seems highly desirable, with a view of further testing its correctness and applicability, that the calculations should be resumed with the aid of more accurate and multiplied observations.

In a subsequent memoir Gauss enters upon a discussion, which is at once elementary and profound, of the general properties of the same potential function which plays so important a part in the "*Allgemeine Theorie des Erdmagnetismus*," ending with a series of propositions on the relations of this function for a distribution of

magnetism—whether entirely upon the surface of the earth, or within it, or in external space—which seem to be the ultimate conclusions to which this theory has hitherto attained or is capable of attaining. This memoir presents a striking illustration of that happy union of analytical skill with philosophical power for which his later writings were so remarkable, and which puts them in striking contrast with the obscurity and extreme compression of some of his earlier productions.

Gauss was born on the 30th of April, 1777. After completing his education at the Collegium Carolinum, he proceeded to the University of Göttingen in 1795; he graduated at Helmstadt in 1799, and afterwards resided as a private teacher in Brunswick until the year 1807, when he was appointed Professor in the University of Göttingen, and Director of the Observatory; a situation which he continued to retain for the remainder of his life. He was twice married, and by his first wife, who died in 1809, he has left one surviving son, and by his second, two sons and a daughter, Theresa, to whom he was tenderly attached, who nursed him, when his health began to decline, with the greatest affection and care.

During the last year of his life the decay of old age began to manifest itself in a disease of the heart, and the usual symptoms which accompany it; and he died in great tranquillity on the morning of the 23rd of February last. "I assisted," writes the Baron von Waltershausen, one of the most distinguished of his pupils, in a letter communicating these facts, "with others of his friends and pupils, in placing his body in his coffin, in binding a laurel crown around his head, and in discharging with filial love and reverence the last honours of the great man, whose name is destined to take its place with those of Archimedes and Newton in the history of the exacter sciences." On the 26th of February, his body, which had lain in state in the Rotunda of the Observatory, was followed to the grave by the whole University, and by a vast multitude of friends and admirers.

GEORGE SIMON OHM was born on the 16th of March, 1787, at Erlangen in Bavaria, where his ancestors had been known as prosperous and skilful locksmiths for several generations. His father's intention was, that he, as well as his younger brother, Martin

Ohm, should learn the family craft; but having himself acquired an amount of knowledge—especially of mathematics—unusual in his station of life, which he had found useful to him in his business, he resolved that his boys should have the advantage of a superior education before entering on their future calling, and accordingly, after they had passed through the Elementary School, he sent them to the Gymnasium. With such opportunities and the example of their father, it is not to be wondered at that the talents of the two brothers were rapidly developed. A new career opened to them in 1804, when the celebrated mathematician Langsdorf having become acquainted with their extraordinary progress, pronounced the judgment that some day they would emulate the brothers Bernouilli. He prepared a certificate to this effect, which induced their father to relinquish his intention of bringing them up to his business, and to allow them thenceforward to pursue a scientific career.

George Simon Ohm entered the University of Erlangen when he had completed his sixteenth year, but he remained there only eighteen months, leaving it to give instructions in mathematics in Switzerland. In August 1806 he became a mathematical tutor in the Institute of Gottstadt near Nidau, in the Canton of Berne; after remaining here two years and a half, he went to Neufchatel, where he spent the next two years and a half as a teacher of mathematics. Towards the end of 1811 he returned to Erlangen, and, after taking his degree, entered on an academical course of life as a *Privat-docent* there. This position, however, was merely temporary, as well as a tutorship which he subsequently held at the “Realschule” of Bamberg, which was soon dissolved.

Ohm attained in 1817, for the first time, a suitable and permanent position as teacher of mathematics in the Great (Jesuits’) Gymnasium at Cologne, where the peculiar faculty he possessed of representing the theory of mathematics in a comprehensive and attractive manner to the youthful understanding was soon recognized. Ohm, however, had an ambition higher than that of remaining a mere mathematical teacher; his genius led him on to travel into the less trodden regions of science, and to try his powers as an original inquirer. It was not long before he found a congenial sphere of action, and was led to discover the true explanation of the hitherto enigmatical phenomena of the voltaic current.

In 1826 he obtained a long leave of absence in order to proceed to Berlin to perfect and publish his new theory, which appeared in 1827 under the title "The Galvanic Circuit mathematically treated, by Dr. G. S. Ohm." When this work first appeared, it had not the fortune to attract notice from the leading scientific men of the day, nor did it gain for its author consideration or favour from the authorities then at the head of the affairs of education and learning in Prussia, by whom, indeed, he was received in a manner which showed an entire misapprehension of his scientific activity and of his great merits. His susceptibilities thus wounded, he did not delay a moment to declare that, after such a reception, it was impossible for him to retain the appointment he held at Cologne. With the deepest feelings of mortification and grief, he left the place, thrown back into private life with most precarious means of existence, and deprived of all the requisite resources for pursuing his investigations. Seven of the best years of his life were in this way lost to science; but from these adverse circumstances he was at last withdrawn in 1833, when the Bavarian government appointed him Professor in the Polytechnic School at Nuremberg.

Whilst Ohm was usefully employed in this new sphere, his theory of the voltaic circuit began to be appreciated both at home and abroad, and in 1841 the Royal Society of London awarded to him the Copley Medal, the highest honour in its power to bestow; and to mark still more its high estimation of the eminent services he had rendered to science, he was elected, in 1842, a Foreign Member of the Society. This judgment, it is acknowledged by his countrymen, had the effect of entirely removing the obstacles which had hitherto impeded his way; the conclusions of his theory became known as "Ohm's laws" in all elementary works on physics, and throughout Europe his position was recognized as among the most eminent philosophers of Germany.

Amidst his active duties as Rector of the Polytechnic School at Nuremberg, and Professor of Physics, he found time to make advances in the scientific career which his theory of the voltaic circuit had opened to him. Physicists have long been convinced that the various forces to which we ascribe the phenomena of Light, Heat, Electricity and Magnetism, must all have a common origin; transformations of one series of phenomena to another have even been

shown experimentally without the known facts having led to the discovery of their intimate connexion. To this important investigation Ohm determined to devote the remainder of his life. The peculiar views which he had adopted in his researches in electricity respecting the interior constitution of bodies and of the molecules of which they consist, appeared to him to throw a new light on the nature and co-relations of the forces referred to. Following out these ideas, he established the general properties, form, and arrangement of the molecules; he attributed to them simple and polar powers; he determined their relations to the various external actions, and thus gradually formed a complete system, from which he saw the phenomena of light, heat, electricity and magnetism evolve themselves.

Of this projected work on 'Molecular Physics,' only one volume has appeared, which was published in 1849 under the general title of "Contributions to Molecular Physics," vol. i., and with the special title of "Elements of Analytical Geometry of three dimensions according to the system of oblique-angled co-ordinates." This introduction he thought necessary, because the ordinary mathematical methods did not appear to him to apply themselves to his ideas with sufficient simplicity and conciseness. He dedicated this work to the Royal Society of London, "whose approbation," he says, "tempered his courage, which had previously been softened by disheartening treatment, to renewed efforts in the field of science."

Whilst Ohm was, with incessant industry, carrying out his great undertaking, he was, towards the end of the year 1849, unexpectedly called to fill the vacant place of Conservator of the Physical Collection at Munich. Agreeable as this appointment must have been to him, and in accordance with the new scientific direction he had taken, still the event is to be regretted, as the arrangement of the Museum and the construction of new instruments withdrew his attention from continuing and completing his great work. During this time he published a memoir of great interest on the phenomena of interference in uniaxal crystals.

In 1852 changes occurred which induced Ohm to relinquish the official position he had gained in Munich and to become Professor of Experimental Physics in the High School of that city. Not contented to restrict himself to the customary demonstrations and explanations, which would have cost him but little exertion, he pre-

pared for his lectures a text-book on Physics, in which many of the subjects were treated in a very original manner. This work was published in 1854.

To complete, within the limited time he saw before him, the labours he had undertaken, required unusual exertions, which his feeble constitution did not enable him to support. His friends remarked with regret the gradual sinking of his forces from the beginning of 1854; he however continued his lectures until a renewed attack of apoplexy suddenly terminated his life on the 7th of July, 1854. "Thus ended," says his biographer, "the noiseless life of a simple and easily contented, but highly gifted man, who lived solely for science, and who had neither sought nor found social advantages, honours, wealth, or what the world is accustomed to consider as chiefly contributing to happiness." About a year before his death, however, the Cross of the Order of Merit of St. Michael was conferred upon him, and he was also made a member of the newly-founded order of Maximilian.

Ohm was a man of small stature. His countenance, although usually earnest, expressed his good nature and modesty. He was little inclined to conversation, but what he spoke was the expression of his soul, always full of matter, and frequently enlivened with wit and sprightly humour. In his life and habits he was extremely simple, contented and temperate. He was fond of solitude, and to this feeling, as well as to the unfavourable circumstances with which he was surrounded at the commencement of his career, was it perhaps owing that he never sought to establish his domestic happiness by marriage.

Besides the works alluded to in this notice, he contributed twelve papers to the Journals of Schweigger and Poggendorff. Two of these relate to Acoustics, one to Physical Optics, and the remainder are on Electrical subjects. The latter consist principally of experimental verifications of his theory, some published before and some after the appearance of his mathematical treatise.

The particulars above stated are derived almost entirely from a detailed memoir on the life and writings of this eminent philosopher communicated to the Royal Academy of Sciences of Munich by Dr. J. Lamont.

REAR-ADMIRAL SIR WILLIAM EDWARD PARRY (Knight) was the fourth son of the late Dr. Caleb Hillier Parry, F.R.S., an eminent physician of Bath, who married Miss Rigby, sister of the late Dr. Rigby of Norwich, and grand-daughter of Dr. Taylor, author of the Hebrew Concordance. He was born at Bath, Dec. 19th, 1790, and received his education at the Grammar School of that city. At the age of twelve he entered the Royal Navy under the patronage of Admiral Lord Cornwallis, who commanded the Channel Fleet, and had his flag flying in the 'Ville de Paris.'

Intelligent, active and ambitious, Parry soon introduced himself to notice, and we find the Admiral making this early mention of him in a letter to a friend. "It is a pity," he writes, "that Mr. Parry had not gone to sea sooner, for he will be fit for promotion long before his time is out." In 1806 Mr. Parry joined the 'Tribune,' Captain Thomas Baker, and subsequently the 'Vanguard' under the command of the same officer, with whom he served the remainder of his time as midshipman. On the 6th of January, 1810, he was promoted to the rank of lieutenant, and appointed to the 'Alexandria,' Captain Quilliam, employed in protecting the Spitzbergen Whale Fishery, and thus became first acquainted with that vast icy element with which in after years he was destined to contend. He subsequently served in the 'Hogue,' 'Maidstone,' and lastly the 'Niger,' Captain Samuel Jackson, C.B. While in the 'Hogue,' he accompanied a detachment of boats, and assisted in the destruction of twenty-seven of the enemy's vessels, three of which were heavy privateers. This and some sharp skirmishes with the gunboats of Denmark, are the only actions with the enemy that fell to the lot of the subject of our memoir, as the peace of 1815 happily put an end to all such exploits.

In 1817 the dangerous state of his father's health obliged him to proceed to England on leave, an event of a momentous character in the career of Parry, for it was at this period that Sir John Barrow brought to the notice of the Admiralty the extraordinary changes which had been reported to have occurred in the state of the Polar ice, and the remarkable advance to a high northern latitude that had been made by Captain Scoresby in a whale-ship, and urged upon the Government the project of renewing the attempts which had been formerly made to reach Behring's Strait by way of the

Polar sea. Hence the commencement of that series of northern voyages, which have so much redounded to the honour of this country, and which afforded to the subject of our memoir an opportunity for the exercise of those high qualifications for the conduct of an arduous and difficult undertaking, which so conspicuously marked his character.

The Admiralty having determined upon sending out two expeditions to the Arctic seas, one in the direction of Spitzbergen and the other through Baffin's Bay, Lieutenant Parry was selected for this service, and on the 14th of January, 1818, he was appointed to the command of the 'Alexander,' a hired vessel commissioned for the purpose of accompanying Captain, afterwards Sir John, Ross on a voyage for the discovery of a north-west passage by way of Davis's Strait.

The Expedition quitted England in April 1818, and although unsuccessful in the accomplishment of the great object of the undertaking, succeeded in circumnavigating Baffin's Bay, and in restoring to that arm of the sea its outline—which had been erased from our charts—nearly as it had been drawn by the early navigator whose honoured name it so deservedly commemorates.

The examination, however, of the various sounds which broke the outline of that inland sea had not been made by the Expedition with that care which was necessary to satisfy the inquiring spirit of Parry, more especially with regard to a wide opening in the coast, to which Baffin had assigned the name of Sir John Lancaster's Sound. This opening, which when discovered by our navigators had excited the brightest expectations, and from which Parry and his associates had been compelled to return with the utmost regret, Parry on his arrival in England found to his astonishment represented as closed by a lofty range of mountains bearing the name of the first Secretary of the Admiralty, Mr. Croker, barring all progress to further discovery in that direction.

The indignation of Parry at this extraordinary misrepresentation may be imagined, and he did not flinch from the responsibility of disclosing his sentiments to the Admiralty, who immediately determined upon sending another expedition to the same quarter to decide the question. Accordingly in the spring of 1819 the 'Hecla' and 'Griper' were fitted for the purpose, and the command entrusted to Lieu-

tenant Parry. The Expedition quitted England in May 1819, and reached Davis's Strait early in July. The progress of the ships being arrested by the ice, which at the early part of the summer was known to the whalers to occupy the upper part of Baffin's Bay, the character of Parry at once showed itself, by a prompt determination to attempt a passage through the opposing boundary. He accordingly dashed into the ice with both his ships with a boldness which deserved success, and accomplished a passage through this great barrier, till then considered impenetrable.

The Expedition reached Lancaster's Sound on the 1st of August, and found it entirely free from ice. "We were now," says Parry, "about to explore that great inlet which had obtained a celebrity beyond what it might otherwise have been considered entitled to possess, from the opposite opinions which had been held with regard to it, and it will be readily conceived how anxious we were to advance." His suspense was not of long duration, for in a very few days he had the high gratification to be able to clear up all doubt, by the advance of the ships over that imaginary chain of mountains which had been drawn across the Sound as if purposely to disarm inquiry, and by the discovery of a wide and magnificent strait opening out into the Polar sea, to which was given the name of Barrow, as a well-deserved compliment to the second Secretary of the Admiralty as the strenuous promoter of Arctic discovery.

Hour after hour rolled away, and the ships continued their uninterrupted progress upon a direct course for Behring's Strait. Who but Parry himself could know the feelings which filled his anxious mind at that time ! His associates, as they witnessed the clear open sea rise in the horizon mile after mile, might be elated at the brilliant prospect before them ; but with Parry the enjoyment was heightened by the full realization of his hopes in this part of his voyage, and by the reflection that the serious responsibility he had incurred before leaving England would now redound to his honour.

Our limited space will not permit us to dwell upon the eventful progress of this, one of the most memorable of the Polar voyages. Suffice it to observe, that it was upon this occasion our navigators discovered the great opening into the Polar sea on the west, Prince Regent's Inlet on the south, Wellington Channel on the north, celebrated in after years as the supposed route of the gallant and

unfortunate Franklin, and farther west the islands known as the Parry Group, beyond which no subsequent expedition, with all the modern improvements and appliances of steam, has been able to proceed; and lastly, they discovered Banks's Land in the south-west, memorable as the furthest point afterwards reached by M'Clure from the opposite direction; an achievement which rendered certain the existence of the long-sought north-west passage. Between this land and the Parry Group there was stretched an impenetrable barrier of ice, which from that time to the present has baffled every effort of our ships, and is the only small tract remaining to be navigated to render evident the practicability of the passage.

But although the endeavours of Parry were not crowned with success, as regarded the main object of the Expedition, yet it will always remain as a bright feature in his distinguished career, that he achieved the discovery of those two remarkable terminating points—the "*ultima Thule*" of the navigation both from the *east* and from the *west*, which no ship from either quarter has yet been able to pass.

Parry in his route towards this terminating point of his discoveries had passed the meridian of 110° west, and the Expedition became entitled to the reward of £5000, which had been offered by the Government as an encouragement to Arctic enterprise.

After an anxious and unavailing suspense in the hope of a favourable change in the ice, Parry put into port, to pass the first dreary winter ever encountered by a Government expedition in so high a latitude: and here the qualities of Parry, which among others so peculiarly fitted him for the conduct of such an undertaking, were displayed in a remarkable manner, in the arrangements of the ship and the establishment of those wholesome regulations for the health and comfort of the crew, and for the occupation of the mind, which he knew so well to be essential to the bodily vigour of the seaman, and to the prevention of that fatal disease the scurvy, which had almost invariably attended previous attempts to brave a winter in the Arctic regions.

Aware of the influence of personal example, he took an active part in the theatrical entertainments which were got up for the diversion of the crew, and being an excellent actor, he contributed in no small degree to their success. On the other hand, he was inde-

fatigable in all astronomical observations, which were carried on night after night upon the snow, with the thermometer frequently 30° below zero, when it was necessary to keep the chronometer in hot sand to prevent its stopping, and to case the telescope in soft leather to prevent its destroying the skin of the face of the observer. We mention these facts once for all, as they serve to illustrate the zeal and determination which marked his character, and how by force of example he stimulated those who had the happiness to serve under his command. In this case the effect was the establishment of the geographical position of his winter quarters with a degree of accuracy probably never attained by any Expedition in the same time, even in a milder latitude ; the lunar observations alone amounting to nearly 10,000.

As the spring advanced he conducted an overland journey across Melville Island, and discovered the sea on the north and Liddon Gulf on the west, where he left his broken cart, which served to mark indisputably his position to M'Clintock, who visited the spot thirty years afterwards and found the precious relic.

The summer of 1820 had well-nigh passed away before there was any possibility of liberating the ships from their winter quarters, and there being no prospect of a change in the great barrier of ice which covered the sea in every direction, and which indeed had never varied, Parry determined upon returning to England, where he arrived in October 1820.

As might be expected, his reception by his country was enthusiastic and most gratifying to him. He was immediately promoted to the rank of Commander. Bath, his native place, presented him with the freedom of its city ; the Bedfordean gold medal was unanimously voted to him with a sum of 500 guineas ; and he was presented with a silver vase, bearing ornamental devices emblematical of the Polar regions.

In December of the same year it was determined to follow up Arctic discovery by another Expedition, the command of which was again given to Parry. The attempt on this occasion was to be made by way of Hudson's Strait and Sir Thomas Rowe's Welcome. The Expedition left England in May 1821, and succeeded in making important additions to the geography of the Arctic seas, in clearing up various doubts respecting the statements

of early navigators, and in the discovery of a strait leading from Sir Thomas Rowe's Welcome into Prince Regent's Inlet. But the undertaking failed in its main object. The strait, which was named after the 'Hecla' and 'Fury,' and which proved to be the only outlet, was found to be impassable, and Parry, after passing two winters and encountering frequent and imminent perils from the rapid tides and whirling masses of ice which beset the ships and irresistibly carried them away from their positions, returned to England. Parry's narrative of this Expedition is one of the most interesting of the Polar voyages, from the long and intimate intercourse which was held with the Esquimaux tribes, and the exquisite embellishments from the pencil of his colleague Captain Lyon.

Immediately on the return of the Expedition, the Admiralty marked the high estimation in which they held the services of its commander by promoting him to the rank of Captain, and appointing him Acting Hydrographer, and the City of Winchester honoured him with its freedom.

A year of repose had scarcely elapsed when Captain Parry was summoned to take command of another Expedition destined to renew the attempt to reach Behring's Strait by way of Prince Regent's Inlet in connexion with an overland expedition under Captain Franklin. Parry left England in 1825 and succeeded only in reaching Port Bowen, where he passed his fourth dreary winter in the Arctic regions, and after experiencing great peril in the following summer from the ice and tides, which occasioned the loss of one of the ships and very nearly that of the other, he returned home.

This was the last of the Expeditions in a north-western direction under Captain Parry. The great energy and perseverance which had been displayed by him on all these occasions left no doubt in the minds of the Admiralty that further efforts in the same direction were likely to be fruitless, and for a while Arctic exploration had a respite. In these memorable voyages, under the command of the subject of our memoir, large acquisitions had been made to the geography of the Polar seas, and science had been promoted by numerous observations of a highly interesting and important character, some of which formed the subject of papers in the Transactions of this Society, by Captain Parry and his distinguished associates, Colonel Sabine and Lieutenant H. Forster.

It was seen, that, under able management and proper discipline, a winter in the Arctic regions could be passed, not only without those dreadful ravages which characterized the early voyages to those seas, but with as little if not less than the average mortality of mankind in civilized countries.

Captain Parry was now confirmed in his office as Hydrographer, and he was honoured by the freedom of the Borough of Lynn. In the autumn of this year Parry determined, since no passage could be found in a north-western direction, to propose to the Admiralty to renew the attempt to reach a high northern latitude by travelling over the vast expanse of ice which occupied the Spitzbergen seas. As early as 1818 a plan for effecting this object by means of light boats drawn by dogs had been submitted to the Admiralty by the late Sir John Franklin and his associate in the 'Trent,' Lieutenant, now Admiral, Beechey, and Parry now undertook to carry it into effect by means of rein-deer. He accordingly sailed in 1827 for Hammerfest, and taking on board a sufficient number of these animals proceeded to Spitzbergen, where he quitted his ship and commenced his perilous journey.

Those persons only who have seen the Spitzbergen ice and are acquainted with its rugged surface and the deep pools of water in its hollows, can judge of the enormous labour and difficulty in travelling over it. Yet Parry overcame these difficulties, and had it not been that the ice at length was found to have a motion to the southward nearly as fast as his party could advance to the northward, he would certainly have accomplished his object. All his efforts, however, were frustrated by this unforeseen circumstance, and after travelling 660 miles, a distance more than sufficient to reach the Pole in a direct line from where he set out, he found himself compelled to return. With what reluctance he submitted to this may be gathered from his journal, in which he observes, "dreary and cheerless as were the scenes we were about to leave, we never turned homewards with so little satisfaction as on this occasion." His furthest point reached on this journey was $82^{\circ} 45' N.$, a parallel which far exceeded any well-authenticated advance which had ever been made before. Had he been able to accomplish fifteen miles more he would have been entitled to the reward of one thousand pounds offered by the Government so long back as the days of Phipps.

On his return to England he resumed his duties as Hydrographer at the Admiralty, where he continued until 1829, when he accepted the office of Commissioner for the management of the affairs of the Australian Company. Before quitting England the King was pleased to mark his approbation of his services by conferring upon him the honour of Knighthood. The University of Oxford bestowed upon him the degree of D.C.L., he was elected a Fellow of this Society, and made an Honorary Member of the St. Petersburg Academy of Sciences, and also a Member of the Royal Irish Academy.

On his arrival in Australia he took up his residence at Port Stephen, a beautiful little bay about sixty miles to the north of Sydney. The quiet repose of this delightful spot was quite in unison with the mind of Parry, and while zealously discharging his duties as Commissioner of the Colony, he managed to promote among the colonists by whom he was surrounded, a spirit of piety and devotion to which they had before been strangers. He built a church, in which, in the absence of any authorized clergyman, he officiated himself.

After a residence of five years in Australia he returned to England, and accepted the office of Poor Law Commissioner in the county of Norfolk. The duties of this appointment were, however, by no means congenial to Parry. He was frequently called upon to adjudicate in cases in which his judgment was at variance with his feelings, and in about a year he resigned his appointment.

About this time he was selected to organize and conduct a newly-created department of the public service with the title of Comptroller of Steam Machinery, and continued to discharge the duties of this office with zeal and ability for ten years. During that time he saw introduced into the Royal Navy the screw-propeller, now so justly regarded as indispensable in our fleets, and did much to extend and improve the steam power of this country.

In 1847, finding his health begin to suffer from the onerous duties of his office, he accepted the appointment of Captain Superintendent of Haslar Hospital, which he held until his promotion to his Flag.

In 1853, the Lieutenant-Governorship of Greenwich Hospital falling vacant, it was offered to Sir Edward Parry, who accepted it, greatly to the satisfaction of his friends, who rejoiced in the expec-

tation that the quiet duties of that appointment would be beneficial to his general health, for they could not fail to notice the inroads which a life of so laborious and anxious a character had made upon his constitution. Scarcely, however, had six months elapsed before symptoms of a dangerous and painful disease became apparent. The probable fatal tendency of this complaint was well known to Parry, but he bore up against its painful effects with christian fortitude, cheerfulness and resignation.

Towards 1855 the approaching fatal termination of his complaint became but too evident, and at the recommendation of his medical advisers he determined to try the waters of Ems, but his bodily strength was unequal to the journey. He was detained for a time at Coblenz by exhaustion; and reached Ems, only to end there his days, for on the 8th of July, 1855, it pleased the Almighty disposer of events to bring to a close his long and varied life of usefulness. Perfectly resigned and full of humble hope he breathed his last, surrounded by his mourning family; giving proof in the closing moments of his existence of the blessed effects of that spirit of piety and devotion which he had so ardently cultivated throughout his life. His remains were conveyed to England and interred with honours in Greenwich Hospital.

Thus terminated the career of one of the most distinguished officers of the age in which he lived, a career as varied and eventful as it was honourable and prosperous: gifted with talents of a general character, he performed with credit whatever he undertook; but in none of his appointments was he more successful than in that of commander of those expeditions of discovery which have so much contributed to his own fame and the honour of his country.

As a member of society, no one stood higher in general estimation: kind, affectionate, of high moral and religious principles, charitable and humane, his memory will long be cherished in quarters where good men most desire to be remembered, more particularly in the wards of Haslar Hospital, and in those useful charitable institutions known as the Sailor's Homes, asylums for the humble members of his profession, for whose temporal and spiritual improvement he had always so strenuously laboured.

Parry left several works behind him. Besides the narratives of his voyages, we find his name associated with three papers in the

Transactions of this Society. A small volume on 'Astronomy by Night,' published early in life; a volume on the 'Parental Character of God,' now undergoing a fifth edition; and an 'Address to the Sailor.' His correspondence with the Admiralty, who consulted him upon all matters connected with the Arctic seas and the search for Sir John Franklin, is voluminous, and with his journals and observations have always been considered most valuable; and his voyages will long keep their places by the side of those of Cook, Anson, Vancouver, and other great navigators. The high estimation in which Parry was held by the Admiralty is marked by these frequent appeals to his opinion, as well as by all his appointments, and by a good-service pension being bestowed upon him; and lastly, by their reply to the Governor of Greenwich Hospital on being informed of his death, viz. that it was with deep regret they learnt that Her Majesty's Service had been deprived of so distinguished an ornament as Sir Edward Parry.

Sir Edward Parry married in 1827 Isabella Louisa, the fourth daughter of the late Lord Stanley of Alderley, who died in May 1839; and secondly, Catherine Edwards, daughter of the Rev. R. E. Hawkinson, and widow of Samuel Hoare, Esq., and left several children.

RICHARD SHEEPSHANKS was born at Leeds, July 30, 1794. His father was engaged in the cloth manufacture, and destined his son to the same pursuit. At the age of fifteen, however, and after an ordinary school education, the son discovered his own preference for a learned profession, and the father accordingly placed him under the care of James Tate, head of the school at Richmond in Yorkshire, well known as one of the most successful teachers of his day. Here he remained until 1812, when he was removed to Trinity College, Cambridge. He took his degree with honours in 1816, obtained a fellowship in the next year, and proceeded to study for the bar, to which he was called about 1822. A weakness of sight, to which he was always subject, is supposed to have been the principal cause of his not practising law: but it must be added that his share of his father's property placed him in easy circumstances, independently of his fellowship, and his taste for science had become very decided. He took orders about 1824, and soon

began to devote himself entirely to astronomy. He became a Fellow of the Astronomical Society in 1834, and of this Society in 1830. Though often actively engaged in our behalf, and serving on the Council in 1832, his pursuits led him towards the Astronomical Society, of which he was always one of the most active of the executive body. His leisure, and his desire to help the young astronomer so long as he wanted advice and guidance, gave a peculiar value to his services, and a peculiar utility to his career.

Mr. Sheepshanks resided in London till about 1842, when he removed to Reading, where he died of apoplexy, August 4, 1855. There is much reason to suppose that his life was shortened by his laborious exertions in the restoration of the standard scale.

Though an ardent politician of the school of opinion which had to struggle for existence during the first half of his life, but gradually became victorious in the second, he never took any public part in a political question, except that of the Reform Bill. He was one of the Boundary Commissioners appointed in 1831 to fix the boundaries of boroughs under the new system of representation. His reading in politics and history was extensive, especially in military matters, with which he was very well acquainted; both ancient and modern tactics, from the best sources, having formed a portion, and no inconsiderable portion, of his studies. To this must be added literature and poetry, to which he was much attached: he never abandoned classical reading, and those who knew him best were often surprised at the extent to which he had cultivated modern literature.

But his subject was astronomy, and his especial part of that subject was the *astronomical instrument*. His reputation among astronomers on this point, and the articles which he contributed to the 'Penny Cyclopædia,' may allow us to regret that he did not draw up a full treatise on a matter which he had so completely fathomed.

Mr. Sheepshanks was engaged in active efforts on several special occasions, to which we make brief allusion. In 1828 he joined Mr. Airy in the pendulum operations in Cornwall, and suggested some of the most important plans of operation. In 1828 and 1829 he was active in the establishment of the Cambridge Observatory. In 1832 he was consulted on the part of the Admiralty, with reference to the edition then preparing of Groombridge's Circumpolar

Catalogue : the result was the appearance of that work in a much more efficient and more creditable form than it would otherwise have appeared in. In 1832 he also interfered in a matter to which, connected as it is with personal differences, we can only here allude, as eliciting much information on the subject of equatorial instruments in general; a result which is entirely due to the part taken by Mr. Sheepshanks. In 1838 he was engaged in the chronometric determination of the longitudes of Antwerp and Brussels: in 1844 in that of Valentia, Kingstown, and Liverpool. In 1843 and 1844, the subject of the Liverpool Observatory led him into a controversy, his pamphlets on which will be useful study to those who are interested in astronomical instruments. He was always an active member of the Board of Visitors at the Royal Observatory at Greenwich.

Mr. Sheepshanks was a member of both the Commissions (of 1838 and 1843) for the restoration of the standards of measure and weight, destroyed by fire in 1834. The standard of measure was placed in the hands of Francis Baily, at whose death Mr. Sheepshanks volunteered (Nov. 30, 1844) to continue the restoration. This matter occupied him closely during the last eleven years of his life. It would not be possible for us to give any detailed account of the operation, a full history of which is to come from the *Astronomer Royal*. We need only say, that after a thorough examination of the process, beginning with the very construction of thermometers,—a point which gave no small trouble,—results were obtained which were embodied in a bill which received the royal assent on the day following that on which Mr. Sheepshanks was struck by the shock which ended his life. The number of *recorded* micrometer observations is just five hundred short of ninety thousand.

Mr. Sheepshanks was especially distinguished by the integrity of his mind, and by his utter renunciation of self in all his pursuits. He did not court fame: it was enough for him that there was a useful object which could be advanced by the help of his time, his thought, and his purse. His consideration for others was made manifest by his active kindness to those with whom he was engaged, and no less by his ready appreciation of the merits of those against whom he had to contend in defence of truth and justice, as they

appeared to his mind. Nor must we omit to add, while using a qualifying expression to save the right of free opinion, and to avoid implying a decision which is not within our province, that in every one of his controversies, that which was truth and justice to the mind of Mr. Sheepshanks was nothing less to the minds of very many from whom no thinking man would differ without cautious examination. He was a devoted friend and a formidable opponent.

On the motion of J. P. Gassiot, Esq., seconded by the Rev. Dr. Booth, the thanks of the Society were given to the President for his excellent address, and his Lordship was requested to permit the same to be printed.

Dr. Roget and William Spence, Esq. having, with the consent of the Society, been nominated Scrutators, the votes of the Fellows present were collected.

The following Noblemen and Gentleman were reported duly elected Officers and Council for the ensuing year:—

President—The Lord Wrottesley, M.A.

Treasurer—Colonel Edward Sabine, R.A.

Secretaries— { William Sharpey, M.D.
George Gabriel Stokes, Esq., M.A.

Foreign Secretary—Rear-Admiral W. H. Smyth.

Other Members of the Council—The Duke of Argyll; Neil Arnott, M.D.; Rear-Admiral F. W. Beechey; Sir Benjamin Brodie, Bart.; William Benjamin Carpenter, M.D.; Arthur Cayley, Esq.; Rev. James Challis, M.A.; Charles Darwin, Esq., M.A.; Sir Philip de M. Grey Egerton, Bart.; William Fairbairn, Esq.; John Miers, Esq.; William Allen Miller, M.D.; William Hallows Miller, Esq., M.A.; James Paget, Esq.; John Stenhouse, LL.D.; Rev. Robert Walker.